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Certified by

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This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

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☐ Additional inventors are being named on the ____ separately numbered sheets attached hereto

TITLE OF THE INVENTION (280 characters max)

METHOD AND APPARATUS PROCESSING NULL PACKETS IN A DIGITAL MEDIA RECEIVER

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* 4 ☐ CD(s), Number ____

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☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fees

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☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: ____.

Respectfully submitted,

SIGNATURE ____ Date 06/18/03

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This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C., 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

METHOD AND APPARATUS PROCESSING NULL PACKETS IN A DIGITAL MEDIA RECEIVER

The SCTE DVS-031 and ITU-T J.83B standards, which are nearly identical, describe a digital transmission system for cable distribution of video, sound and data services. The data format input to the physical layer (channel coding and modulation) is assumed to be MPEG-2 transport. However, the method used for MPEG-2 synchronization is de-coupled from the Forward Error Correction (FEC) synchronization, unlike many other digital transmission standards. This feature was intended to introduce the flexibility, for example, to enable the system to carry Asynchronous Transfer Mode (ATM) packets easily without interfering with ATM synchronization. However, an unintended aspect of this feature is the increased probability of false locks in the MPEG-2 synchronization detector. In particular, when the data is quasi-periodic as for example, when there is a substantial number of null packets in the data stream, the MPEG-2 synchronization detector can falsely lock to one of several wrong positions in the packet and send invalid packets to the transport block even when the FEC is perfectly locked and delivers an error free data stream. This invention detects these false lock conditions by internally detecting the presence of null packets in the data stream and instructing the sync detector to lock to the correct sync byte position found by the null packet detector.

In accordance with the principles of the present invention, the design of an MPEG-2 synchronization detector in a digital cable receiver compliant with the SCTE DVS-031 and ITU-T J.83B standards, like the U.S. digital cable system. In broadcasting, the data stream may contain repetitive null packets, which may cause the MPEG synchronization detector to lock to the wrong synchronization position. The current invention solves the MPEG synchronization detection problem when null packets exist in the data stream.

The instant invention is described in the context of an MPEG-2 synchronization detector in a digital cable receiver compliant with the SCTE DVS-031 and ITU-T J.83B standards, like the U.S. digital cable system. Although

described in such a context, the invention should not be construed as being so limited and applies equally to all receiving devices (in addition to cable receivers) in which the problem addressed by the present invention may be applied.

The SCTE DVS-031 and ITU-T J.83B standards describe a digital transmission system for cable distribution of video, sound and data services. In particular, the SCTE DVS-031 describes the adopted standard for digital cable transmission in the U.S. In both standards, the data format input to the physical layer (channel coding and modulation) is assumed to be MPEG-2 transport. The MPEG-2 transport layer is comprised of data packets having 188 bytes, with one byte for synchronization purposes (called sync byte and having a constant value of 47Hex), three bytes of header containing service identification, scrambling and control information, followed by 184 bytes of MPEG-2 or auxiliary data.

In the physical layer, the MPEG transport framing is the outermost layer of processing. This processing block receives an MPEG-2 transport data stream consisting of a continuous stream of fixed length packets that are transmitted in serial fashion, most significant bit (MSB) first. It then locks to the sync byte and delivers MPEG packet synchronization to the following receiver blocks, including the transport block. The output of this block may include an output clock, the data stream, in serial or parallel format, a sync signal identifying the position of the sync byte in the data stream, a valid signal identifying when data is present at the output data stream and an error signal identifying whether the packet is considered invalid (uncorrectable errors) or error free.

Unlike many other digital transmission standards, the method used for MPEG-2 synchronization in the digital cable standards mentioned above is de-coupled from the Forward Error Correction (FEC) synchronization. First, the MPEG-2 packet does not contain an integer number of FEC frames, or even Reed-Solomon (RS) codewords. Hence, the MPEG-2 packets and the FEC frames, or the MPEG-2 packets and RS codewords are asynchronous with respect to each other. Second, the sync byte was replaced at the transmission site by a parity checksum that is a coset of an FIR parity check linear block code. Hence, the MPEG-2 transport framing block needs to decode this parity check

block code in order to recover the sync byte and then lock to it.

This MPEG-2 synchronization de-coupling feature was intended to introduce the flexibility, for example, to enable the system to carry Asynchronous Transfer Mode (ATM) packets easily without interfering with ATM synchronization. However, an unintended consequence of this feature is the increased probability of false locks in the MPEG-2 synchronization detector within the MPEG-2 transport framing block. This happens because the parity check block code is not very powerful and its decoder generally indicates several places in a packet where a possible sync byte could be found, when only one is the correct one. This occurs even when the FEC is perfectly locked and delivers an error free data stream. Luckily, the data stream does not generally present a periodic characteristic and after being processed by the parity check block decoder, different packets will tend to only have the correct sync positions in common. However, in the case of a data stream with a considerable number of null packets, for example, this problem becomes evident and the lock detector may lock to one of the wrong positions identified by the parity check block decoder. As long as there are enough null packets multiplexed in the data stream on a regular basis, this may be enough to keep the lock detector falsely locked for a long time. After a lock detection, the MPEG-2 sync detector inserts the sync byte in the position identified by the parity check block decoder, creates the sync signal, the valid signal and error signal and sends the data stream to the transport layer. In the case of a false lock, the transport layer cannot easily identify a wrong packet, since it is receiving 188 data bytes, with a first byte being the sync byte, a valid signal in line with the bytes, and error signal indicating an error free packet.

This invention detects these false lock conditions by internally detecting the presence of null packets and instructing the sync detector to lock to the correct sync byte position found by the null packet detector. The invention consists of three major blocks: the normal checksum based synchronization detector, null packet detector, and decision logic block, as explained below:

a) The checksum based synchronization detector implements the syndrome generator circuitry and supporting logic for the MPEG-2

synchronization decoder proposed in the SCTE DVS-031 and ITU-T J.83B standards. When the input MPEG-2 data stream is average data/video/audio, which are random in nature, the circuit should produce the correct MPEG-2 synchronization position.

b) The null packet detector takes advantage of the characteristics of null packets. Null packets usually have a predetermined preamble followed by zeros. The detector first detects the preamble and, upon the detection of the preamble, begins to check if the subsequent data bits are all zeros. If the preamble is found and all subsequent data bits are zeros, a null packet is considered found. In the actual implementation, to increase the robustness of the detection against noise and interference, the number of ones is counted in the data area to compare against a programmable threshold. Upon the detection of the preamble and subsequent number of ones within the threshold, the null packet detector will generate a detect signal. To increase detection reliability, a state machine is built to let the detection circuit have a hysteretic characteristic.

c) The logic of the decision block is the following: When the null packet detector detects no null packet, MPEG synchronization is generated by the checksum based synchronization detector. Otherwise, when null packets are detected, the MPEG synchronization from the null packet detector will be used as the MPEG synchronization signal.

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